
अतप्त लघुकृत कार्बन इस्पात की चादर एवं पत्ती

भाग 2 उच्च तन्यता एवं मल्टी-फेस स्टील
(छठा पुनरीक्षण)

Cold Reduced Carbon Steel Sheet and Strip

Part 2 High Tensile and Multi-phase Steel
(*Sixth Revision*)

ICS 77.140.50

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भारतीय मानक ब्यूरो

BUREAU OF INDIAN STANDARDS

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FOREWORD

This Indian Standard (Part 2) (Sixth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Wrought Steel Products Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1954 and revised in 1963, 1973, 1986, 1994 and 2008. While reviewing this standard, in the light of experience gained during these years, the Committee decided to revise it to bring in line with the present manufacturing and trade practices being followed in the country in this field.

This standard is published in two parts. The other part in the series is:

Part 1 Cold forming and drawing purpose

With the constant requirement of greater, stringent and varied requirements for steel sheets and strips for automobile industry and engineering applications, many specifications were made. An endeavour is made to identify, summarize and create a new standard. An attempt is made to cover all such requirements of Automobile and Engineering application under a single standard. However, interested parties as per their requirement may apply more stringent requirement against any clause in this standard or specify other characteristics not covered by this standard.

In the present version following modifications are made:

- a) New designations and grades are added;
- b) Existing standard is divided into two parts, based on the strength level;
- c) Classification of grades has been added;
- d) Tables for chemical composition, variation in product analysis and mechanical properties are changed as per the new designations and grades; and
- e) Clause on mechanical and physical properties, surface finish, freedom from defects and dimensions and tolerances have been modified.

Assistance has been derived from the following:

- | | | |
|----|------------|---|
| a) | EN 10268 | Cold rolled steel flat products with high yield strength for cold forming |
| b) | EN 10338 | Hot rolled and cold rolled non-coated products of multiphase steels for cold forming
— Technical delivery conditions |
| c) | JFS A 2001 | Cold-rolled steel sheet and strip for automobile use |
| d) | JIS G 3135 | Cold reduced high strength steel sheet and strip with improved formability for automobile structural uses. |

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 “Rules for rounding off numerical values (*revised*)”. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

COLD REDUCED CARBON STEEL SHEET AND STRIP

PART 2 HIGH TENSILE AND MULTI-PHASE STEEL

(*Sixth Revision*)

1 SCOPE

This standard (Part 2) covers the requirements of cold reduced carbon high tensile and multi-phase steel sheets and strips for forming and where the surface is of prime importance. It covers sheets and strips up to 3.0 mm thick both in coil form and cut lengths.

2 REFERENCES

The following standards contain provisions which through in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
228 (Relevant Parts)	Method for chemical analysis for steel
1501 (Parts 1 to 4) : 2013	Metallic materials — Vickers hardness test (<i>fourth revision</i>)
1586 (Parts 1 to 3) : 2012	Metallic materials — Rockwell hardness test (<i>fourth revision</i>)
1599 : 2012	Metallic materials — Bend test (<i>third revision</i>)
1608 : 2005	Metallic material — Tensile testing at ambient temperature (<i>third revision</i>)
1956 (Part 4) : 2013	Glossary of terms relating to iron and steel: Part 4 Flat products (<i>second revision</i>)
8910 : 2010	General technical delivery conditions of steel and steel products
10175 : 2012	Metallic materials — Sheet and strip — Erichsen cupping test
11999 : 2007	Method for determination of plastic strain ratio 'r' for sheet metals
15262 : 2002	Geometrical product specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters

<i>IS No.</i>	<i>Title</i>
15756 : 2007	Metallic materials — Sheet and strip — Determination of tensile strain hardening exponent
IS/ISO 16162 : 2012	Cold-rolled steel sheet products — Dimensional and shape tolerances (<i>first revision</i>)

3 TERMINOLOGY

3.1 For the purpose of this standard the definitions given in IS 1956 (Part 4) shall apply.

3.2 Classification of Grades

Sheets and strips shall be classified as per the following groups and designated as per Table 1.

3.2.1 High Strength Low Alloy (LA)

Steel exhibit good impact and fatigue strengths. Steels that contain micro alloy additions to achieve the required strength.

3.2.2 C, Mn Steel (W)

Steel exhibit high strengths with relatively lower yield stress. Steel that is strengthened by the addition of Carbon and Manganese, to achieve the required strength. (Minimum tensile strength greater than 440 MPa.)

3.2.3 Dual Phase Steel (Y)

Steel with very high tensile strengths and low yield ratio. Steels are strengthened with a microstructure of ferrite and martensite, created by a suitable heat treatment.

3.2.4 TRIP Steel (T)

Transformation induced plasticity. Steel exhibit outstanding combination of high strength and ductility. Steels that are strengthened by retained austenite obtained by suitable heat treatment which transforms into martensite due to application of higher strain.

3.2.5 Complex Phase (C)

Steel exhibit very high tensile strength with high yield stress and also good elongation. Steels are

Table 1 Designation and Grades
(Clause 3.2)

Designation (Quality) (1)	Grade (2)	Available Product Range, mm (3)
High Strength Low Alloy	ISC310LA	0.40-3.00
	ISC320LA	0.40-3.00
	ISC350LA	0.40-3.00
	ISC380LA	0.40-3.00
	ISC410LA	0.40-3.00
	ISC440LA	0.60-3.00
	ISC470LA	0.60-3.00
	ISC510LA	0.60-3.00
	ISC550LA	0.60-3.00
	ISC590LA	0.60-3.00
	ISC600LA	0.70-3.00
	ISC700LA	0.80-3.00
	ISC860LA	0.80-3.00
C, Mn Steel	ISC490W	0.60-3.00
	ISC540W	0.60-3.00
	ISC590W	0.60-3.00
Dual Phase Steel	ISC450Y	0.60-2.50
	ISC490Y	0.60-2.50
	ISC540Y	0.60-2.50
	ISC590YL	0.60-2.50
	ISC590Y	0.60-2.50
	ISC590YH	0.60-2.50
	ISC780Y	0.60-2.50
	ISC780YH	0.60-2.50
	ISC980YL	0.80-2.50
	ISC980Y	0.80-2.50
	ISC980YH	0.80-2.50
	ISC1180Y	0.80-2.50
	ISC1180YL	0.80-2.50
	ISC1180YH	0.80-2.50
TRIP Steel	ISC590T	0.60-2.50
	ISC690T	0.70-2.50
	ISC780T	0.70-2.50
Complex Phase Steel	ISC600C	0.60-2.50
	ISC780C	0.60-2.50
	ISC980C	0.80-2.50
Martensitic Steel	ISC900M	0.80-2.50
	ISC1100M	0.80-2.50
	ISC1300M	0.80-2.50
	ISC1500M	0.80-2.50
Hot Forming Grades	ISC480HF	0.60-2.50

NOTES

1 For any thickness greater than or less than the mentioned range, the same can be produced as mutually agreed to between the manufacturer and the purchaser. Acceptance criteria for the range out of available product range shall be as agreed to between the purchaser and the manufacturer.

2 Nomenclature of grade is explained in Annex A.

strengthened with a microstructure of different phases and extreme fine grain refinement.

3.2.6 Martensitic Steel (*M*)

Steel exhibit very high tensile strength and yield stress and are strengthened with high amount of martensite.

3.2.7 Hot Forming Grades (*HF*)

Steel exhibit very high tensile properties, which are obtained through a process of hot forming and subsequent suitable quenching method.

4 SUPPLY OF MATERIAL

4.1 General requirements relating to the supply of cold rolled low carbon steel sheets and strip conform to IS 8910.

4.2 Sheets and strips may be supplied either with mill or trimmed edges.

5 MANUFACTURE

5.1 The method of manufacture of steel and subsequent processing for production of steel sheet and strips shall be left at the discretion of the manufacturer or as agreed to between the manufacturer and the purchaser.

5.2 Sheets and strips shall be supplied rimmed, semi-killed or killed as agreed between the manufacturer and purchaser.

6 CHEMICAL COMPOSITION

- a) The ladle analysis of steel, when carried out either by the methods specified in relevant parts of IS 228 or any other established international instrumental/chemical method, shall be as given in Table 2. In case of any dispute, the procedure given in relevant parts of IS 228 shall be the referee method.
- b) Alternatively, the method specified in relevant ISO standard may be used.
- c) *Product Analysis* – Permissible variation in the case of product analysis from the limits specified in Table 2 shall be as given in Table 3.

7 MECHANICAL AND PHYSICAL PROPERTIES

7.1 Tensile Test

7.1.1 Tensile shall be carried out only, if specified by the purchaser.

7.1.2 When specified, tests shall be carried out in accordance with IS 1608 and mechanical properties shall conform to the requirements specified in Table 4A and 4B.

7.1.3 Tensile test values apply to the direction mentioned in Table 4A and 4B.

7.1.4 The yield stress values apply to the 0.2 percent proof stress, if the yield stress is not clearly distinctive, otherwise the values apply to the lower yield stress.

7.2 Bend Test

7.2.1 Bend test shall be carried out in accordance with IS 1599.

7.2.2 The angle of bend and the internal diameter for the different grades of material shall be as given in Table 5.

7.2.3 The axis of the bend shall be in the direction of rolling. The test pieces shall be deemed to have passed the test if the outer convex surface is free from cracks.

7.2.4 Bend test is not a mandatory requirement for this standard. The same can be applied with mutual agreement between the manufacturer and the purchaser.

7.3 Tensile Strain Hardening Component – *n*-Value

7.3.1 The tensile strain hardening is an index of the stretch-ability (*n*-90), shall be applicable only to thickness between 0.50 mm and 2.00 mm. For thickness more than 2.00 mm, then-*n*-value is reduced by 0.02.

7.3.2 The tensile strain hardening component shall be tested in accordance with IS 15756 and results shall conform to as given in Table 4A and 4B.

7.4 Retest

If a test does not give the specified results, two additional tests shall be carried out at random on the same lot. Both retests shall conform to the requirements of this standard, otherwise the lot shall be rejected.

8 SURFACE FINISH

8.1 Cold Reduced Steel Sheet and Strip

This product is normally supplied skin passed (*see 8.2*), but may be supplied annealed last (that is without skin pass), if specified by the purchaser before placing the order.

8.2 Skin Pass

The purpose of skin passing is one or more the following:

- a) To temporarily minimize the appearance of coil breaks, stretcher strains (Luder lines)

Table 2 Chemical Composition
(Clause 6)

Grade	C Percent, <i>Max</i>	Mn Percent, <i>Max</i>	S Percent, <i>Max</i>	P Percent, <i>Max</i>
(1)	(2)	(3)	(4)	(5)
ISC310LA	0.10	1.00	0.025	0.070
ISC320LA	0.10	1.00	0.025	0.070
ISC350LA	0.10	1.20	0.025	0.030
ISC380LA	0.12	1.40	0.025	0.030
ISC410LA	0.12	1.50	0.025	0.030
ISC440LA	0.12	1.60	0.025	0.030
ISC470LA	0.14	1.60	0.025	0.030
ISC510LA	0.14	1.80	0.025	0.030
ISC550LA	0.14	1.80	0.025	0.030
ISC590LA	0.16	2.50	0.025	0.070
ISC600LA	0.16	2.50	0.025	0.070
ISC700LA	0.16	2.50	0.025	0.070
ISC860LA	0.18	3.00	0.025	0.070
ISC490W	0.20	2.00	0.030	0.050
ISC540W	0.20	2.50	0.030	0.050
ISC590W	0.25	2.50	0.030	0.050
ISC450Y	0.15	2.00	0.020	0.100
ISC490Y	0.15	2.00	0.020	0.100
ISC540Y	0.15	2.20	0.020	0.100
ISC590YL	0.15	2.50	0.020	0.100
ISC590Y	0.15	2.50	0.020	0.100
ISC590YH	0.15	2.50	0.020	0.100
ISC780Y	0.18	2.50	0.020	0.100
ISC780YH	0.18	2.50	0.020	0.100
ISC980YL	0.25	3.50	0.020	0.100
ISC980Y	0.25	3.50	0.020	0.100
ISC980YH	0.25	3.50	0.020	0.100
ISC1180Y	0.30	4.00	0.020	0.100
ISC1180YL	0.30	4.00	0.020	0.100
ISC1180YH	0.30	4.00	0.020	0.100
ISC590T	0.30	2.20	0.015	0.100
ISC690T	0.35	2.50	0.015	0.100
ISC780T	0.35	2.50	0.015	0.100
ISC600C	0.18	2.20	0.015	0.100
ISC780C	0.18	3.00	0.015	0.100
ISC980C	0.20	3.50	0.015	0.100
ISC900M	0.25	3.50	0.015	0.100
ISC1100M	0.30	4.00	0.015	0.100
ISC1300M	0.30	4.00	0.015	0.100
ISC1500M	0.30	4.00	0.015	0.100
ISC480HF	0.32	2.00	0.015	0.050

NOTES

1 Restricted chemistry can be mutually agreed to between the purchaser and the manufacturer.

2 When the steel is aluminium killed, the total aluminium content shall not be less than 0.02 percent. When the steel is silicon killed, the silicon content shall not be less than 0.10 percent. When the steel is aluminium silicon killed, the silicon content shall not be less than 0.03 percent and total aluminium content shall not be less than 0.01 percent. If mutually agreed, for aluminium killed steel, aluminium content can be less than 0.02 percent.

3 The nitrogen content of the steel shall not be more than 0.012 percent.

4 The steel can be made with micro alloying elements like Chromium, Nickel, Niobium, Vanadium, Titanium, Molybdenum, Boron, Calcium and others, either added individually or in combination. For hot forming grades, limit of boron shall be 0.006 percent maximum.

Table 3 Variation in Product Analysis
(Clause 6)

Element	Specified Chemical Composition Limit, percent <i>Max</i>	Variation over Specified Limit, percent, <i>Max</i>
(1)	(2)	(3)
Carbon	≤0.15 >0.15	0.02 0.03
Manganese	0.60 >0.60 to ≤1.15 >1.15	0.03 0.04 0.05
Sulphur	≤0.050	0.005
Phosphorus	≤0.050 >0.050	0.005 0.010
Silicon	≤0.60 >0.60	0.03 0.06
Micro Alloy	—	Subject to mutual agreement between the purchaser and the manufacturer

NOTE — For carbon content less than 0.10 percent, variation over specified limit can be mutually agreed to between the purchaser and the manufacturer.

or fluting during fabrication of finished parts;

- b) To obtain the required surface finish suitable for ordinary decorative painting; and
- c) To control the shape.

Some increase in hardness and some loss in ductility will result from skin passing.

8.3 Strain Ageing

Because of strain ageing factors, it is essential that the period of final processing at the mill and fabrication be kept to minimum. Rotation of stock, by using oldest material first, is important. Stocking of such steels for extended periods of time should be avoided; for optimum performance the period should not exceed six weeks.

8.4 Surface Condition

Grades are supplied either of the surface qualities A or B.

8.4.1 Surface Quality A (Unexposed)

Imperfections such as pores, slight imperfections, small marks, minor scratches and slight colouring, which do not affect the formability or the application of surface coatings are permitted.

8.4.2 Surface Quality B (Exposed)

The better surface shall be free of imperfections, which might affect the uniform appearance of quality coating. The other surface shall at least conform to surface quality A.

8.4.3 Unless otherwise agreed, a single surface of the product shall comply with the specified requirements. On mutual agreement between the manufacturer and the purchaser, any one of the applicable surface or both the surfaces (For Strip — Outside/ Inside surface, For Sheet — Top/Bottom Surface) shall comply with the requirements.

8.4.4 The other surface shall be such that during subsequent treatment it does not have a deleterious effect on the better surface.

8.4.5 Grades of this part of the standard are generally supplied in surface quality A.

8.5 Surface Finish

8.5.1 Cold reduced steel sheet and strip may be supplied in a bright finish and matt finish, dull in appearance, which is suitable for ordinary decorative painting but is not recommended for electro plating. Surface roughness may be given subject to mutual agreement between the manufacturer and the purchaser.

8.5.2 When cold reduced sheet and strip is deformed during fabrication, localized areas may roughen to some degree and such affect portions of the part may require hand finishing to prepare the surface for the intended application.

8.5.3 Designation of surface finish shall be as per Table 6.

8.6 Oiling

As a deterrent to rusting, a coating of oil is usually applied to the product. The oil is not intended as a drawing or forming lubricant and should be easily removable with degreasing chemicals. The product may be ordered not oiled, if required, in which case, the supplier has no responsibility, if oxidation occurs. For type of oiling, Table 7 can be referred (reference purpose only).

9 FREEDOM FROM DEFECTS

9.1 The finished sheets and strips shall be reasonably free from harmful defects such as scale, rust, blisters, laminations, pitting, porosity, cracked or torn edges or any other defects which are harmful to the intended use.

9.2 The degree or amount of surface defects in a strip may be expected to be more than in cut lengths because of the impossibility of rejecting portions of a strip. The purchaser should take this into account and the percentage of admissible defects may be agreed at the time of the enquiry and order.

9.3 The sheets shall be reasonably flat and edges

Table 4A Mechanical Properties at Room Temperature in as Delivered Condition (Cut Lengths and Coils)
(Clauses 7.1.2, 7.1.3 and 7.3.2)

Grade	Minimum Tensile Strength MPa	Yield Point or Proof Stress MPa				Elongation, percent Gauge Length- 50 mm									Test Piece Direction
		Thickness, <i>t</i> , mm				Thickness, <i>t</i> , mm									
		<i>t</i> < 0.40	0.40≤ <i>t</i> <0.80	0.80≤ <i>t</i> <1.00	<i>t</i> ≥1.00	<i>t</i> < 0.40	0.40≤ <i>t</i> <0.60	0.60≤ <i>t</i> <0.80	0.80≤ <i>t</i> <1.00	1.00≤ <i>t</i> <1.20	1.20≤ <i>t</i> <1.60	1.60≤ <i>t</i> <2.00	2.00≤ <i>t</i> <2.50	<i>t</i> > 2.50	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)		(14)	
ISC590LA	590	—	430-580	420-570	410-560	—	—	17-32	17-32	18-33	18-33	≥18		T	
ISC490W	490	—	305-410	295-400	295-400	—	—	23-35	23-35	24-36	24-36	≥24		T	
ISC540W	540	—	335-440	325-430	325-430	—	—	20-32	20-32	21-33	21-33	≥21		T	
ISC590W	590	—	365-470	355-460	355-460	—	—	17-29	17-29	18-30	18-30	≥18		T	
ISC450Y	450	—	270-360	260-370	250-340	—	—	26-42	27-43	28-44	29-45	≥29		T	
ISC490Y	490	—	310-410	300-400	290-390	—	—	22-38	23-39	24-40	25-41	≥25		T	
ISC540Y	540	—	340-450	330-440	320-430	—	—	18-35	19-36	20-37	21-38	≥21		T	
ISC590YL	590	—	300-400	290-390	280-380	—	—	18-33	19-34	20-35	21-36	≥23		T	
ISC590Y	590	—	340-460	330-450	320-440	—	—	17-32	18-33	19-34	20-35	≥21		T	
ISC590YH	590	—	440-560	430-550	420-540	—	—	16-31	17-32	18-33	19-34	≥19		T	
ISC780Y	780	—	440-610	430-600	420-590	—	—	12-25	13-26	14-27	15-28	≥16		T	
ISC780YH	780	—	570-690	560-680	550-670	—	—	11-24	12-25	13-26	14-27	≥14		T	
ISC980YL	980	—	—	590-740	580-730	—	—	--	10-20	11-21	12-22	≥13		T	
ISC980Y	980	—	—	590-930	580-920	—	—	--	9-20	10-21	11-22	≥12		T	
ISC980YH	980	—	—	730-930	720-920	—	—	--	9-19	10-20	11-21	≥12		T	
ISC1180Y	1 180	—	—	835-1 225	825-1215	—	—	--	5-16	6-17	7-18	≥7		T	
ISC1180YL	1 180	—	—	750-1 010	740-1000	—	—	--	6-16	7-17	8-18	≥8		T	
ISC1180YH	1 180	—	—	870-1 210	860-1200	—	—	--	5-16	6-17	7-18	≥7		T	

Table 4A (Concluded)

Grade	Minimum Tensile Strength MPa	Yield Point or Proof Stress MPa				Elongation, percent Gauge Length- 50 mm									Test Piece Direction
		Thickness, <i>t</i> , mm				Thickness, <i>t</i> , mm									
		$t < 0.40$	$0.40 \leq t < 0.80$	$0.80 \leq t < 1.00$	$t \geq 1.00$	$t < 0.40$	$0.40 \leq t < 0.60$	$0.60 \leq t < 0.80$	$0.80 \leq t < 1.00$	$1.00 \leq t < 1.20$	$1.20 \leq t < 1.60$	$1.60 \leq t < 2.00$	$2.00 \leq t < 2.50$	$t > 2.50$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)		(14)	
ISC590T	590	—	370-520	360-510	350-500	—	—	27-42	28-43	29-44	30-45	≥31		T	
ISC690T	690	—	390-540	380-530	370-520	—	—	22-37	23-38	24-39	25-40	≥25		T	
ISC780T	780	—	420-570	410-560	400-550	—	—	17-32	18-33	19-34	20-35	≥21		T	
ISC600C	600	—			350-510	—	—	≥16						T	
ISC780C	780	—			500-700	—	—	≥10						T	
ISC980C	980	—			700-900	—	—	—	≥8					T	
ISC900M	900	—	—	700-1 000		—	—	—	≥3					T	
ISC1100M	1 100	—	—	860-1 100		—	—	—	≥3					T	
ISC1300M	1 300	—	—	1 030-1 300		—	—	—	≥2					T	
ISC1500M	1 500	—	—	1 200-1 500		—	—	—	≥2					T	
ISC480HF	480	—	330-430	320-420	310-410	—	—	19-32	20-33	21-34	22-35	≥23		T	

Table 4B Mechanical Properties at Room Temperature in as Delivered Condition (Cut Lengths and Coils)
(Clauses 7.1.2, 7.1.3 and 7.3.2)

Grade	Minimum Tensile Strength MPa	Yield Point or Proof Stress MPa			Minimum Elongation, percent Gauge Length- 80 mm			Test Piece Direction	Tensile Strain Hardening Component (<i>n</i> -90)
		Thickness, <i>t</i> , mm			Thickness, <i>t</i> , mm				
		$t \leq 0.50$	$0.50 < t \leq 0.70$	$t > 0.70$	$t \leq 0.50$	$0.50 < t \leq 0.70$	$t > 0.70$		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ISC310LA	310	210-310	210-290	210-290	26	28	30	T	≥0.16
ISC320LA	320	240-340	240-320	240-320	24	26	28	T	≥0.15
ISC350LA	350	260-360	260-340	260-340	22	24	26	T	≥0.15
ISC380LA	380	300-400	300-380	300-380	19	21	23	T	≥0.14
ISC410LA	410	340-440	340-420	340-420	17	19	21	T	≥0.13
ISC440LA	440	—	380-480	380-480	15	17	19	T	≥0.12
ISC470LA	470	—	420-520	420-520	13	15	17	T	≥0.11
ISC510LA	510	—	460-580	460-580	—	11	13	T	—
ISC550LA	550	—	500-620	500-620	—	10	12	T	—
ISC600LA	600	—	≥550	≥500	—	11	11	T	—
ISC700LA	700	—	—	≥650	—	—	10	T	—
ISC860LA	860	—	—	830	—	—	4	T	—

NOTES for Table 4A and 4B

- 1 1 N/mm² = 1 MPa = 0.1020 kgf/mm².
- 2 Stricter mechanical properties requirement may be agreed to between the manufacturer and the purchaser, before placing the order.
- 3 Mechanical properties apply only to annealed followed by skin-passed products.
- 4 The values of yield stress are the 0.2 percent proof stress for products which do not represent a marked yield point and the lower yield stress for the others.
- 5 Test Piece Direction – L : Rolling Direction, Test Piece Direction – T: Perpendicular to rolling direction
- 6 Any additional test may be carried out as per mutual agreement between the manufacturer and the purchaser
- 7 *Choice of Properties:* Properties are applicable as per thickness range provided in Table 4A and 4B. If mutually agreed to between the manufacturer and purchaser and properties range (yield point or proof stress and elongation) is not required as per thickness range, then minimum and maximum values of the respective grade (yield point or proof stress and elongation), shall be considered as limits of yield point or proof stress and elongation. For example in Grade ISC590LA, properties are not required as per thickness range, then limits of yield point or proof stress: 410-580 MPa and elongation : 17 percent, *Min*.
- 8 (—) → Not required.

Table 5 Bend Test
(Clause 7.2.2)

Minimum Tensile Strength, MPa	Bend Angle	Bend Radius
(1)	(2)	(3)
340	180°	Close
370	180°	Close
390	180°	Close
440	180°	Close
490	180°	Close
540	180°	0.5 Thickness
590	180°	1.0 Thickness
780	180°	3.0 Thickness
900	180°	4.0 Thickness
980	180°	4.0 Thickness
1100	180°	4.0 Thickness
1300	180°	4.0 Thickness
1500	180°	4.0 Thickness

NOTE — For grades, where minimum tensile requirement is not mentioned in the above table, nearest minimum tensile strength value can be applied.

Table 6 Surface Finish
(Clause 8.5.3)

Surface Finish Class	Surface Finish Designation	Surface Roughness (μm)
(1)	(2)	(3)
Dull Finish	D	$0.50 \leq R_a \leq 2.00$
Bright Finish	B	$R_a \leq 0.60 \mu\text{m}$

NOTES

1 Surface roughness R_a is the average roughness in accordance with IS 15262.

2 Restricted range of surface roughness can be agreed to between the manufacturer and the purchaser.

3 Unless and otherwise mentioned, general condition of surface shall be Dull Finish with surface designation D.

cleanly sheared and squared to the specified dimensions.

10 DIMENSIONS AND TOLERANCES

10.1 Unless and otherwise agreed to between the manufacturer and the purchaser, standard dimensions of cold rolled sheets and strips shall be as given below:

Thickness, mm = 0.40, 0.45, 0.50, 0.55, 0.63, 0.70, 0.80, 0.90, 1.00, 1.20, 1.25, 1.40, 1.50, 1.60, 1.80 and 2.00

The following are the preferred thickness for sheets above 2.00 mm:

Thickness, mm = 2.50, 2.65 and 3.00 mm.

10.2 Dimensional and shape tolerances applicable to cold rolled sheets and strip shall be as given in IS/ISO 16162. Stricter dimensional tolerances can be agreed to between the manufacturer and the purchaser.

Table 7 Type of Oiling
(Clause 8.6)

Type of Oiling	Description
(1)	(2)
Normal rust preventive oil	Commonly used for steel strip and sheet for rust prevention
Special rust preventive oil	High lubrication rust preventive oil Solid lubricant For rust prevention and better frictional properties during press work
No oiling	Surface will be dry and prone to oxidation

NOTE — Above table for the purpose of reference only.

10.3 For untrimmed edges, width tolerances shall be $^{+20\text{mm}}_{-0}$ and for edges which are trimmed before cold rolling, width tolerances shall be $^{+7\text{mm}}_{-0}$. For edges trimmed after coldrolling and annealing, width tolerances shall be as per ISO 16162.

11 SAMPLING AND TESTS

11.1 One representative sample from a strip or a lot of sheets shall be taken for tensile testing. A lot consists of 50 tonnes or less of sheets or strips of the same quality rolled to same thickness and processed in same condition. If the lot consists of more than one heat, samples from each heat shall be tested.

11.2 For bend tests, one sample each lot of 50 tonnes of same heat or part thereof or one sample from each coil shall be taken.

11.3 The specimens shall not undergo any treatment on either surface before testing. In case of strips, samples shall be taken from the beginning or end of the strip.

11.4 The centre of each test piece shall be at a quarter widths. When it is not feasible, however the sampling should be made as close to the aforementioned position as possible.

12 MARKING AND PACKING

12.1 Marking

The following shall be legibly marked or printed on a sticker attached on the top of each bundle of package of sheets/on a tag attached to each coil:

- Manufacturer's name or trade-mark;
- Quality designation and grade;
- Product dimensions;
- Cast or identification mark by which the sheet or strip may be traced to cast or casts from which they were made; and
- Mass/Net weight.

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12.2 BIS Certification Marking

The material may also be marked with the Standard Mark.

12.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the *Bureau of Indian Standards*.

12.3 Packing

- a) Each sheet shall be treated on both sides with non-hardening type rust preventive oil,

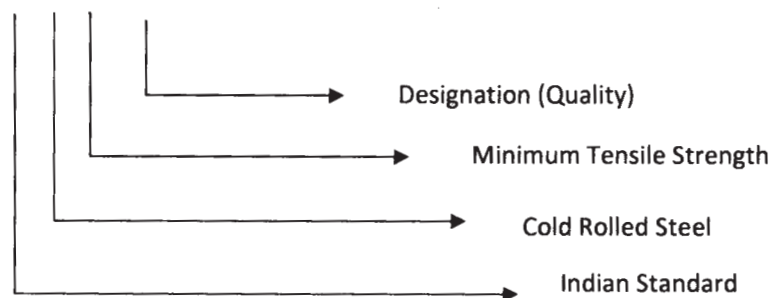
which can be easily washed with aqueous alkali solution;

- b) Sheets and strips shall preferably be supplied in bundles or packages not weighing more than 3 tonnes or as agreed to between the purchaser and the manufacturer; and sheets and strips shall be securely packed in water resistant material and cover all over with steel envelope and securely tied round with steel straps and preferably with wooden battens underneath to prevent the sheets from rusting and damage during transit.

ANNEX A (Table 1 Note 2)

NOMENCLATURE OF GRADE

IS C 590 LA



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This Indian Standard has been developed from Doc No.: MTD 04 (5364).

Amendments Issued Since Publication

Amendment No.	Date of Issue	Text Affected

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